USB-1208HS-4AO

USB-based High-Speed Analog and Digital I/O Module

User's Guide

MEASUREMENT COMPUTING

USB-1208HS-4AO

USB-based High-Speed Analog and Digital I/O Module

User's Guide

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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the USB-1208HS-4AO so that you get the most out of its USB data acquisition features.

This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:
1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:
The *InstaCal* installation procedure is explained in the Quick *Start Guide.*
Never touch the exposed pins or circuit connections on the board.

Where to find more information

The following electronic documents provide helpful information relevant to the operation of the USB-1208HS-4AO.

- MCC's *Specifications: USB-1208HS-4AO* (the PDF version of the *Specifications* chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/USB-1208HS-4AO.pdf.
- MCC's *Quick Start Guide* is available on our web site at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.
- MCC's *Guide to Signal Connections* is available on our web site at www.mccdaq.com/signals/signals.pdf.
- MCC's *Universal Library User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf.
- MCC's *Universal Library Function Reference* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.
- MCC's *Universal Library for LabVIEW™ User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/SM-UL-LabVIEW.pdf.

USB-1208HS-4AO User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/USB-1208HS-4AO.pdf.

Introducing the USB-1208HS-4AO

This user's guide contains all of the information you need to connect the USB-1208HS-4AO to your computer and to the signals you want to measure.

The USB-1208HS-4AO is a USB 2.0 high-speed device supported under popular Microsoft® Windows® operating systems. The USB-1208HS-4AO is compatible with both USB 1.1 and USB 2.0 ports, (although the speed of the module maybe limited when using USB 1.1 ports)

With a multiplexed 13-bit A/D converter for all analog input channels, the USB-1208HS-4AO can sample:

- up to eight single-ended analog inputs
- up to four differential analog inputs

A digital trigger lets you start analog input and / or analog output scans.

The USB-1208HS-4AO also has 16 digital I/O connections. The port has 47 kΩ resistors that you can configure for pull-up/pull-down using a jumper inside the case. The default configuration is pull-down.

You can configure each digital bit for either input (power on default) or output.

The USB-1208HS-4AO also includes four 12-bit analog outputs, two 32-bit counters that can count TTL pulses, and one 32-bit timer.

The USB-1208HS-4AO is powered by the +5 volt USB supply from your computer, and requires no external power.

The USB-1208HS-4AO is shown below. All I/O connections are made to the screw terminals located along each side of the USB-1208HS-4AO.

USB-1208HS-4AO functions are illustrated in the block diagram shown here.

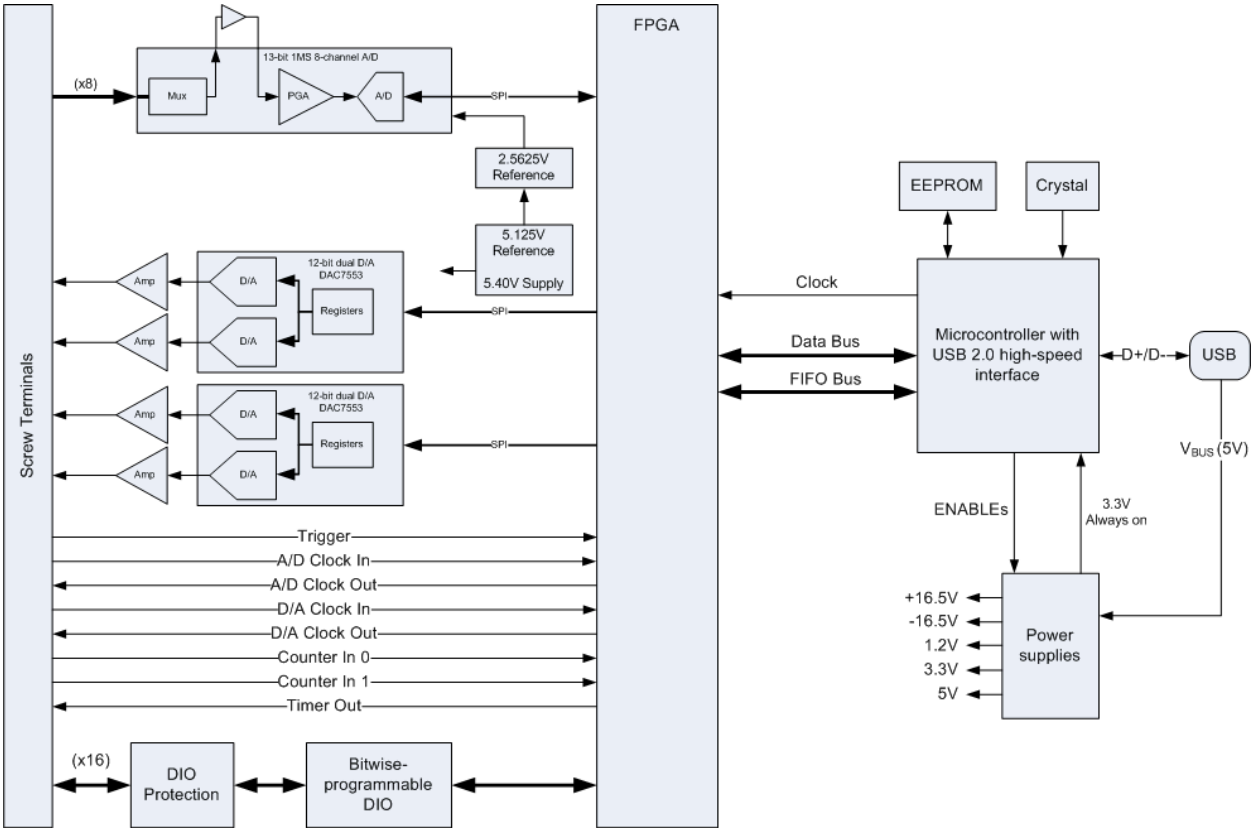


Figure 1. USB-1208HS-4AO functional block diagram

Software features

For information on the features of *Insta*Cal and the other software included with your USB-1208HS-4AO, refer to the *Quick Start Guide* that shipped with your device. The *Quick Start Guide* is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Check www.mccdaq.com/download.htm for the latest software version.

Installing the USB-1208HS-4AO

What comes with your USB-1208HS-4AO shipment?

As you unpack your USB-1208HS-4AO, verify that the following components are included.

Hardware

- USB-1208HS-4AO

- USB cable (2 meter length)

Additional documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your USB-1208HS-4AO and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Unpacking the USB-1208HS-4AO

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the USB-1208HS-4AO from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If your USB-1208HS-4AO is damaged, notify Measurement Computing Corporation immediately by phone, fax, or email.

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

For international customers, contact your local distributor. Refer to the "International Distributors" section on our contact web page (\www.mccdaq.com/contact/).

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Installing the hardware

Be sure you are using the latest system software

Before you install your USB-1208HS-4AO, run Windows Update to update your operating system with the latest USB drivers.

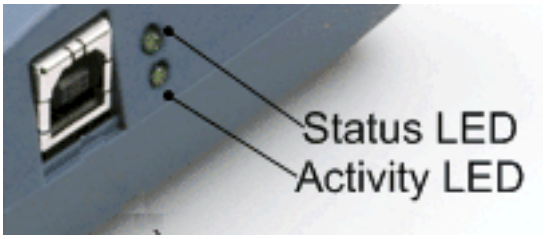
Install the MCC DAQ software before you install your board

The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board. Refer to the *Quick Start Guide* for instructions on installing the software.

Connecting the USB-1208HS-4AO to your system

To connect the USB-1208HS-4AO to your system, turn your computer on, and connect the USB cable to a USB port on your computer or to an external USB hub connected to your computer. The USB cable provides power and communication to the USB-1208HS-4AO.

When you connect the USB-1208HS-4AO for the first time, a **Found New Hardware** dialog opens when the USB-1208HS-4AO interface is detected. The "Status" LED on the USB-1208HS-4AO turns on at this time, indicating the USB-1208HS-4AO is detected and installing on your computer.



When the dialog closes, the installation is complete.

Caution! Do not disconnect **any** device from the USB bus while the computer is communicating with the USB-1208HS-4AO, or you may lose data and/or your ability to communicate with the USB-1208HS-4AO.

If the Status LED turns off

If the Status LED lights up but then turns off, the computer has lost communication with the USB-1208HS-4AO. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This should restore communication, and the LED should light up again.

Calibrating the USB-1208HS-4AO

The USB-1208HS-4AO is shipped fully calibrated. Calibration coefficients are stored in EEPROM.

Return the device to Measurement Computing Corporation when calibration is required. The normal calibration interval is once per year.

Functional Details

Theory of operation - analog input acquisition modes

The USB-1208HS-4AO can acquire analog input data in two basic modes – software paced and continuous scan.

Software paced mode

You can acquire one analog sample at a time in software paced mode. You initiate the A/D conversion by calling a software command. The analog value is converted to digital data and returned to the computer. You can repeat this procedure until you have the total number of samples that you want.

The throughput sample rate in software paced mode is system-dependent, and can range from 33 S/s to 4000 S/s.

Continuous scan mode

You can acquire data from up to eight channels in continuous scan mode. The analog data is continuously acquired, converted to digital values, and written to an onboard FIFO buffer on the USB-1208HS-4AO until you stop the scan. The FIFO buffer is serviced in blocks as the data is transferred from the USB-1208HS-4AO FIFO buffer to the memory buffer on your computer.

The maximum sampling rate is 1 MS/s aggregate over one-to-eight channels. You can start a continuous scan with either a software command or with an external hardware trigger event.

External components

The USB-1208HS-4AO has the following external components, as shown in Figure 2.

- Screw terminal banks (two)
- USB connector
- LEDs

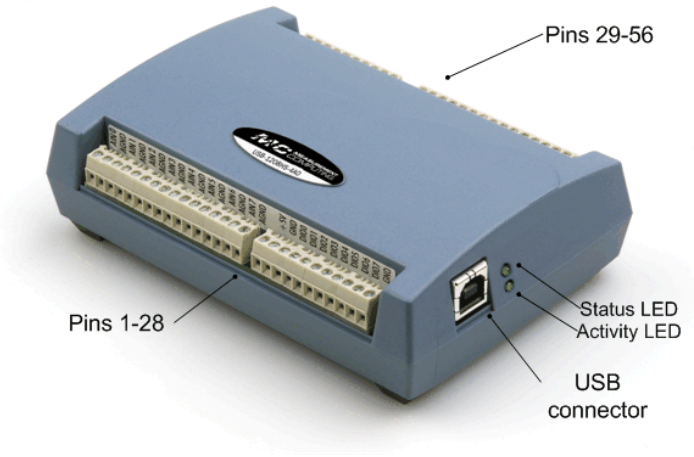


Figure 2. USB-1208HS-4AO external components

USB connector

The USB connector provides +5 V power and communication. No external power supply is required.

Activity LED

The Activity LED indicates the communication status of the USB-1208HS-4AO. It flashes when data is transferred, and is off when the USB-1208HS-4AO is not communicating. This LED uses up to 10 mA of current and cannot be disabled.

Status LED

The Status LED lights up when the USB-1208HS-4AO is detected and installed on your computer.

Screw terminals

The USB-1208HS-4AO module's screw terminals provide the following connections:

- Eight analog input connections (**AIN0** to **AIN7**)
- 16 digital I/O connections (**DI00** to **DI015**)
- Four analog output connections (**AOUT0** to **AOUT3**)
- 10 analog ground connections (**AGND**)
- Six digital ground connections (**GND**)
- One external clock input (**AICKI**) and one external clock output (**AICKO**) for analog inputs
- One external clock input (**AOCKI**) and one external clock output (**AOCKO** for analog outputs
- One digital trigger input (**TRIG**)
- Two counter inputs (**CTR0**, **CTR1**)
- One timer output (**TMR**)
- Two 5 V power output connections (**+5 V**)

Use 16 AWG to 30 AWG for signal connections. The screw terminal signals are shown in Figure 3.

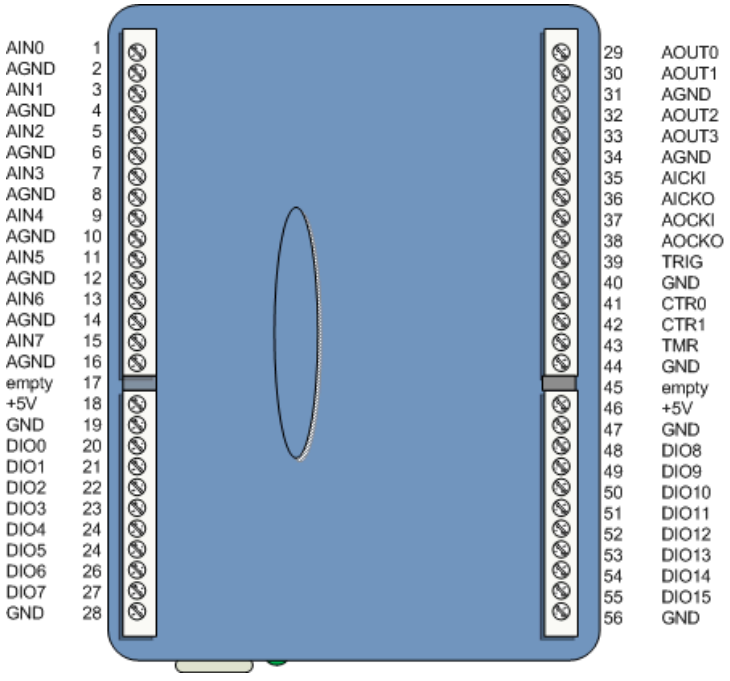


Figure 3. USB-1208HS-4AO screw terminal signals

Analog input terminals

You can connect up to eight analog input connections to the screw terminals labeled **AIN0** through **AIN7**.

Input configuration

Analog signals are referenced to analog ground (AGND).

Single-ended mode requires two wires:

- The wire carrying the signal to be measured connects to AINx.
- The second wire connects to AGND.

Differential mode requires two wires plus a ground reference:

- The wire carrying the positive portion of the differential signal to be measured connects to AINx.
- The wire carrying the negative portion of the differential signal to be measured connects to AIN(x+1).
- The analog ground reference wire connects to AGND.

The terminal configurations for single-ended and differential modes are shown in the table below.

Channel #	**8 single-ended channels configuration 0**	
	V_{in}+	V_{in}-
0	AIN0	AGND
1	AIN1	AGND
2	AIN2	AGND
3	AIN3	AGND
4	AIN4	AGND
5	AIN5	AGND
6	AIN6	AGND
7	AIN7	AGND

4 differential channels configuration	
V_{in}+	V_{in}-
AIN0	AIN1
AIN2	AIN3
AIN4	AIN5
AIN6	AIN7
-	-
-	-
-	-
-	-

In single-ended mode, the input voltage ranges are ±10 V, ±5 V, ±2.5 V, 0 to 10 V.

In differential mode, the input voltage ranges are ±20 V, ±10 V, and ±5 V. The voltage level on each AINx input is limited to ±14 V

The following image depicts a voltage source connected to a USB-1208HS-4AO configured for single-ended mode.

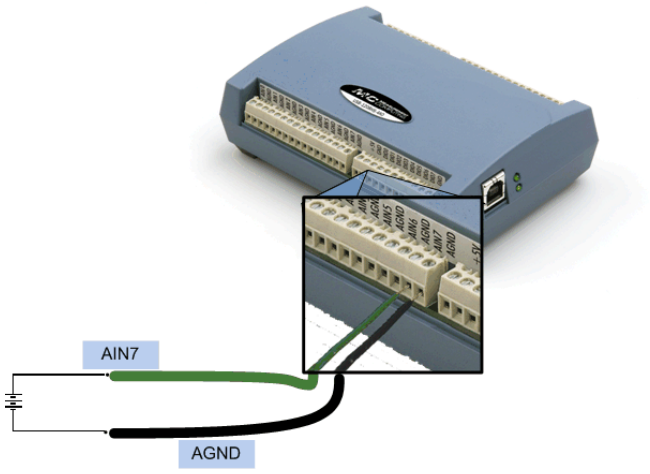


Figure 4. Single-ended measurement connection

The following image depicts a Wheatstone bridge signal source connected to a USB-1208HS-4AO configured for differential mode.

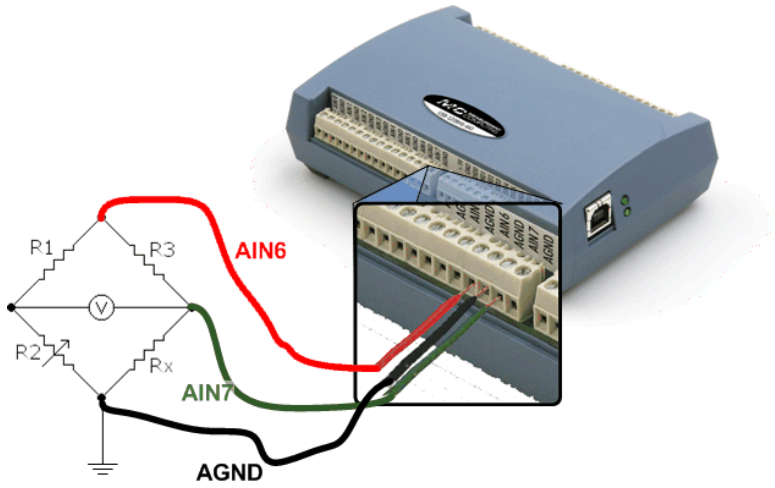


Figure 5. Differential measurement connection

For more information on analog signal connections

For more information on single-ended inputs, refer to the *Guide to Signal Connections* (this document is available on our web site at www.mccdaq.com/signals/signals.pdf).

Analog output terminals

You can connect up to four analog output connections to screw terminals **AOUT0** to **AOUT3**. Refer to the pinout diagram on page 12 for the location of these pins.

Each channel can be software-paced at rates up to 5,000 updates per second (system-dependent), or hardware-paced at rates up to 1 MS/s.

Each analog output on the USB-1208HS-4AO has a fixed ±10 V output range. The outputs default to 0 V at power up.

External clock I/O terminals

Use the **AICKI** and **AOCKI** terminals to receive a sampling clock from an external source.

Use the **AICKO** terminal to output the internal A/D sampling clock. Use the **AOCKO** terminal to output the internal D/A sampling clock. When using an external clock, a pulse output generated by the external clock rising edge is also available at these terminals.

Digital I/O terminals

You can connect up to 16 digital I/O lines to screw terminals **DIO0** through **DIO15**. Refer to the pinout diagram on page 12 for the location of these pins.

The 16 DIO terminals have 47 k resistors that you can configure for pull-up/pull-down using a jumper inside the case. The default configuration is pull-down.

You can use the USB-1208HS-4AO digital I/O terminals to detect the state of any TTL-level input. Refer to the switch circuit shown in Figure 6 and the schematic shown in Figure 7. If you set the switch to the +5 V input, DIO0 reads *TRUE* (1). If you move the switch to GND, DIO0 reads *FALSE* (0).

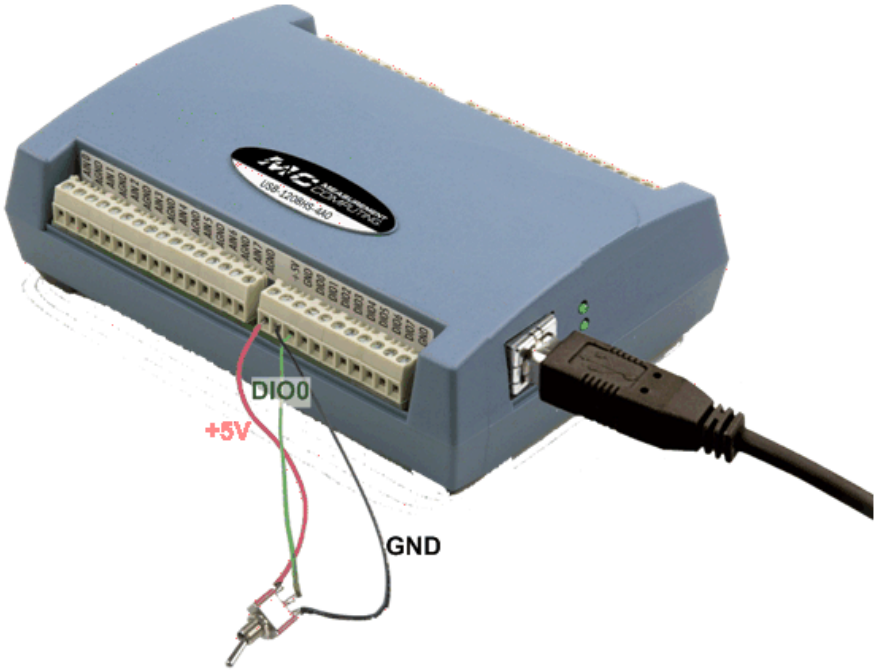


Figure 6. Digital connection DI0 detecting the state of a switch

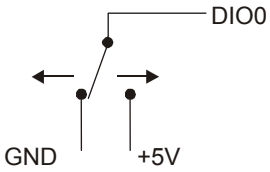


Figure 7. Schematic showing switch detection by digital channel DIO0

Internal pull-up/pull-down capability

Each of the 16 DIO bits on the USB-1208HS-4AO has a 47 kΩ pull-up/pull-down resistor. To configure these bits for either a +5 V pull-up or a 0 V pull-down option, you must open the USB-1208HS-4AO case to access the three-pin jumper labeled W34.

The pull-up/pull-down voltage is common to all of the internal 47 kΩ resistors.

To open the case and set the W34 jumper, do the following.

1. Turn over the USB-1208HS-4AO and rest it on its top on a flat, stable surface.
2. Peel off the four rubber feet on the bottom of the module to access the screws.
3. Remove the four screws shown in Figure 8 from the bottom of the module.

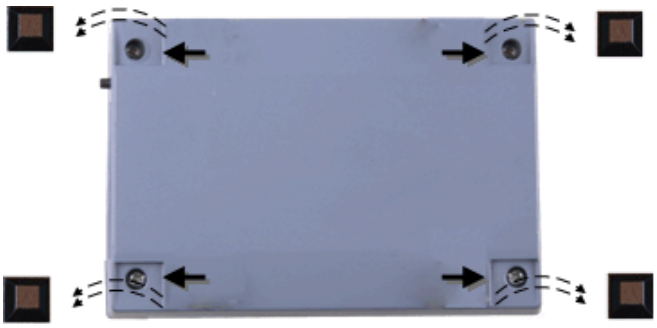


Figure 8. Location of screws connecting bottom and top sections of case

4. Holding both the top and bottom sections of the module, turn it back over, rest it on the surface, and carefully remove the top section of the case.

5. Set the jumper to either pull-up or pull-down (see Figure 9 and Figure 10).

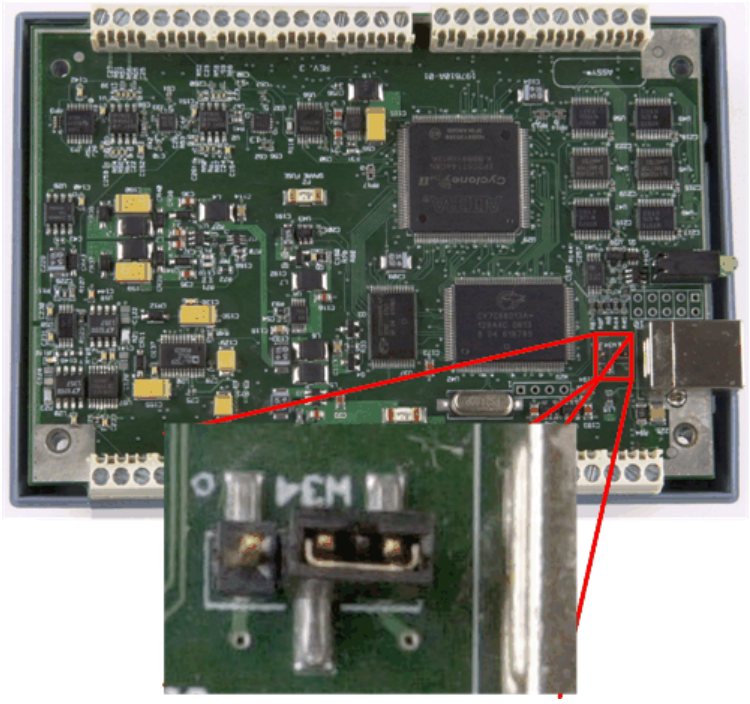


Figure 9. Location of W34 jumper (default pull-down setting shown)

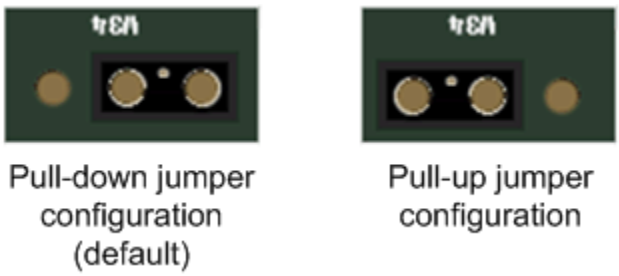


Figure 10. W34 jumper – pull-down and pull-up configurations

6. Replace the top section of the case, and then fasten it to the bottom section with the four screws.

For more information on digital signal connections

For general information regarding digital signal connections and digital I/O techniques, refer to the *Guide to Signal Connections* (available on our web site at www.mccdaq.com/signals/signals.pdf).

Counter I/O terminals

The terminals provide connections to each 32-bit counter input channel (**CTR0** and **CTR1)**. Each counter can count frequencies of up to 20 MHz.

Timer output terminal

Use the **TMR** terminal to connect to the pulse width modulation (PWM) timer output.

You can set the following timer output parameters through software:

- pulse frequency
- duty cycle (pulse width divided by the pulse period)
- number of pulses to generate
- time delay before starting the timer output after it's enabled
- resting state of the output (*idle high* or *idle low*)

The timer can generate a pulse output with a programmable frequency range of 0.00931 Hz up to 20 MHz.

Both the period and time delay ranges are 50 ns to 107.4 seconds.

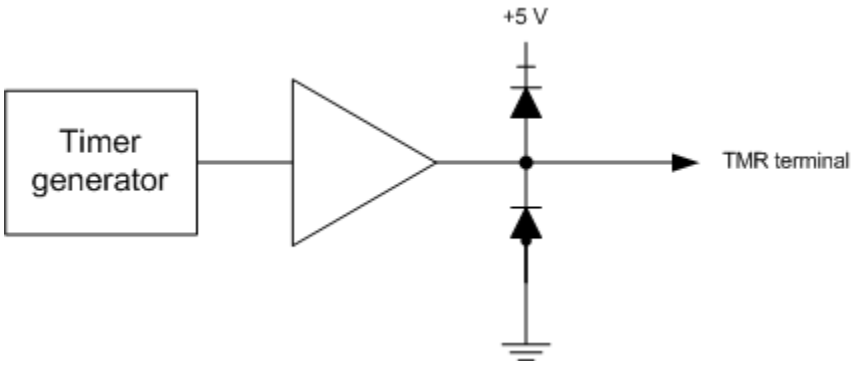


Figure 11. USB-1208HS-4AO PWM timer channel

Trigger input terminal

The **TRIG** connection is an external digital trigger input. The trigger mode is software selectable for:

- Level-sensitive or edge-sensitive
- Rising or falling edge
- High or low level

The default setting at power up is edge sensitive, rising edge.

Retrigger

The acquisition uses the trigger settings for positive edge/negative edge and level-sensitive/edge-sensitive, but automatically re-arms the trigger after it is activated

Power terminals

You can use the two **+5V** connections to supply power to external devices or circuitry. These terminals can output up to 285 mA. Refer to the pinout diagram on page 12 for the location of this pin.

Caution! The **+5V** terminals are outputs. Do not connect to an external power supply or you may damage the USB-1208HS-4AO and possibly the computer.

Analog ground terminals

The 10 analog ground (**AGND**) connections provide a common ground for all analog I/O channels. Refer to the pinout diagram on page 12 for the location of the **AGND** terminal pins.

Common ground terminals

The six ground (**GND**) connections provide a common ground for the digital I/O, timer/counter I/O, timer, clock I/O, and the +5 V terminals. Refer to the pinout diagram on page 12 for the location of the **GND** terminals.

Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Analog input

Table 1. Analog input specifications

Parameter	Conditions	Specification
A/D converter		Analog Devices AD7329 - 13-bit successive approximation type
Input ranges	Software-selectable per channel	▪ Differential: ±20 V, ±10 V, ±5 V (The voltage level on each individual AIN input is limited to ±14 V.) ▪ SE: ±10 V, ±5 V, ±2.5 V, 0 – 10 V
Number of channels		4 differential/8 single-ended, software selectable
Input configuration		Multiplexed
Channel gain queue	8 unique consecutive elements	Software configurable range for each channel
Absolute maximum input voltage	*CHx IN to GND.*	*±25 V maximum (power on)* *±12 V maximum (power off)*
Input impedance		35 MΩ minimum.
Input bandwidth (-3 db)	All input ranges	2 MHz typical
Input leakage current		±250 nA typical
Input capacitance		32 pf typical
Offset error drift		5 ppm/°C typical
Gain error drift		25 ppm/°C typical.
Maximum working voltage (signal + common mode)	±20 V	±14 V
	±10 V	±11 V
	±5 V	±5.5 V
Sampling rate		1 S/s to 1 MS/s, software programmable
Sample clock source		Internal A/D clock or AICKI
Burst mode		Software selectable, burst rate = 1µs
Throughput	Software paced	33 to 4000 S/s typical, system dependent
	Scan to PC memory	1 MS/s maximum
Resolution		13 bits
A/D no missing codes (uncalibrated)	*Differential Mode*	*13 bits*
	Single-ended Mode	*12 bits*
CMRR	*60hz*	*74 dB typical*
Crosstalk	*Single-ended mode, All ranges, 250 kHz input signal*	*-62dB typical*
	Differential mode, all ranges, 250 kHz input signal	*-78 dB typical*

Table 2. Calibrated absolute accuracy

Range	Accuracy (mV)
±20 V (differential mode)	±9.55 typical, ±13.18 maximum
±10 V (differential mode)	±4.59 typical, ±6.23 maximum
±5 V (differential mode)	±2.25 typical, ±2.75 maximum
±10 V (single-ended mode)	±5.10 typical, ±8.06 maximum
±5 V (single-ended mode)	±2.63 typical, ±4.03 maximum
±2.5 V (single-ended mode)	±1.59 typical, ±2.70 maximum
0 – 10 V (single-ended mode)	±3.29 typical, ±5.13 maximum

Table 3 summarizes the noise performance for the USB-1208HS-4AO. Noise distribution is determined by gathering 50 kS with inputs tied to ground at the user connector. Samples are gathered at the maximum specified sampling rate of 1 MS/s.

Table 3. Noise performance

Range	Typical counts	LSBrms
±20 V (differential mode)	3	0.45
±10 V (differential mode)	3	0.45
±5 V (differential mode)	3	0.45
±10 V (single-ended mode)	5	0.91
±5 V (single-ended mode)	5	0.91
±2.5 V (single-ended mode)	5	0.91
0 – 10 V (single-ended mode)	5	0.91

Table 4. Input settling time in µs, typical

Condition	Range	±1 LSB	±4 LSB	±8 LSB
+ full-scale to – full-scale channel switch, same range to same range	±10 V	1.5	1.1	1.0
	±5 V	2.1	1.1	1.0
	±2.5 V	2.2	1.1	1.0
	0-10 V	2.6	1.1	1.0

Analog output

Table 5. Analog output specifications

Parameter	Conditions	Specifications
D/A converter		Texas Instruments DAC7553
Number of channels		4 independent
Resolution		12 bits
Output range	Calibrated	±10 V
	Uncalibrated	±10.2 V
Output transient	Host PC is reset, powered on, suspended, or a reset command is issued to device.	Duration: 3 ms typical Amplitude: 6 V p-p typical
D/A update rate	Software paced	33 to 5000 S/s typical, system dependent
	Hardware paced	1 MHz maximum (per channel)
Sample clock source		Internal D/A clock or AOCKI
Monotonicity		*12 bits*
Output current		±3 mA maximum per channel
Output short-circuit protection	Output connect to GND	Unlimited duration (10 mA typical)
Output coupling		DC
Power up and reset state		0 V
Output noise		*0.53 mV rms*
Settling time (to 0.05%)	*20 V output step, (R_L=5 kΩ, C_L=200 pf)*	*5 µS maximum.*
Absolute accuracy		±0.1%
Slew rate		6.7 V/µs typical
Offset error drift		10 ppm/°C typical
Gain error drift		65 ppm/°C typical

Digital input/output

Table 6. Digital I/O specifications

Digital type	CMOS
Number of I/O	16
Configuration	Each bit may be configured as input (power on default) or output
Pull-up configuration	The port has 47 kΩ resistors configurable as pull-ups or pull-downs via internal jumper (default setting is pull-down.)
Digital I/O transfer rate (system-paced)	33 to 8000 port reads/writes or single bit reads/writes per second typical, system dependent.
Input high voltage	2.0 V minimum 5.5 V absolute maximum
Input low voltage	0.8 V maximum –0.5 V absolute minimum 0 V recommended minimum
Output high voltage	4.4 V minimum (IOH = -50 µA) 3.76 V minimum (IOH = -24 mA)
Output low voltage	0.1 V maximum (IOL = 50 µA) 0.44 V maximum (IOL = 24 mA)
Output current	±24 mA maximum per terminal (see "Power"section for additional information)

External trigger

Table 7. External trigger specifications

Parameter	Specification
Trigger source	TRIG input
Trigger mode	Software configurable for edge or level sensitive, rising or falling edge, high or low level. Power on default is edge sensitive, rising edge.
Trigger latency	1 µs + 1 clock cycle maximum
Trigger pulse width	100 ns minimum
Input type	Schmitt Trigger, 33 Ω series resistor and 47 kΩ pull-down to ground
Schmitt trigger hysteresis	0.4 V to 1.2 V
Input high voltage	2.2 V minimum 5.5 V absolute maximum
Input low voltage	1.5 V maximum –0.5 V absolute minimum 0 V recommended minimum

External clock input/output

Table 8. External clock I/O specifications

Parameter	Specification
Terminal names	AICKI, AICKO, AOCKI, AOCKO
Terminal types	AxCKI: Input, active on rising edge AxCKO: Output, power on default is 0 V, active on rising edge
Terminal descriptions	AxCKI: Receives sampling clock from external source
	AxCKO: Outputs internal sampling clock (D/A or A/D clock) or pulse generated from AxCKI when in external clock mode
Input clock rate	1 MHz maximum.
Clock pulse width	AxCKI: 400 ns minimum
	AxCKO: 400 ns minimum
Input type	Schmitt trigger, 33 Ω series resistor, 47 kΩ pull-down to ground
Schmitt trigger hysteresis	0.4 V to 1.2 V
Input high voltage	2.2 V minimum 5.5 V absolute maximum
Input low voltage	1.5 V maximum –0.5 V absolute minimum 0 V recommended minimum
Output high voltage	4.4 V minimum (IOH = -50 µA) 3.76 V minimum (IOH = -24 mA)
Output low voltage	0.1 V maximum (IOL = 50 µA) 0.44 V maximum (IOL = 24 mA)
Output current	±24 mA maximum per terminal (see "Power" section for additional information)

Counters

Table 9. Counter specifications

Counter terminal names	CTR0, CTR1,
Counter type	Event counter
Number of channels	2
Input type	Schmitt trigger, 33 Ω series resistor, 47 kΩ pull-down to ground
Schmitt trigger hysteresis	0.4 V to 1.2 V
Input high voltage	2.2 V minimum 5.5 V absolute maximum
Input low voltage	1.5 V maximum –0.5 V absolute minimum 0 V recommended minimum
Resolution	32 bits
Counter read/write rates (software paced)	33 to 8000 reads/writes per second typical, system dependent
High pulse width	*25 ns minimum*
Low pulse width	*25 ns minimum*

Timer

Table 10. Timer specifications

Timer terminal name	TMR
Timer type	PWM output with count, period, delay, and pulse width registers
Output value	Default state is idle low with pulses high, software selectable output invert
Internal clock frequency	40 MHz
Register widths	32 bits
High pulse width	*20 ns minimum*
Low pulse width	*20 ns minimum*
Output high voltage	4.4 V minimum (IOH = -50 µA) 3.76 V minimum (IOH = -24 mA)
Output low voltage	0.1 V maximum (IOL = 50 µA) 0.44 V maximum (IOL = 24 mA)
Output current	±24 mA maximum per pin (see "Power" section for additional information)

Memory

Table 11. Memory specifications

Data FIFO	4 kS analog input/4 kS analog output
Non-volatile memory	32 KB (16 KB firmware storage, 16 KB calibration/user data)

Power

Table 12. Power specifications

Parameter	Conditions	Specification
Operating modes		Bus-powered, USB 5 V supply
Supply current (see Note 1)	Suspend mode	<2.5 mA
	Enumeration	<100 mA
	Run mode	<500 mA
Power consumption excluding analog and digital outputs	Run mode	1.175 W maximum (235 mA input current)
Power available for +5 V, AICKO, AOCKO, TMR, analog outputs, digital I/O	Run mode	1.325 W maximum The total power consumption for all external loads must be less than this value and each load must meet the individual specification for the terminal.
Digital output power calculation		Power per output = Iout * 5 V (for example, @ 24 mA, P = 0.024*5 = 120 mW/output)
Analog output power calculation		Power per output = (Iout * 16.5 V)/0.78 (for example, @ 3 mA, P = (0.003*16.5)/0.80 = 63.5 mW/output)
+5 V output power calculation		Power (W) = Iout * 5 V
+5 V output voltage range (see Note 2)	Run mode	4.5 V minimum, 5.25 V maximum
	Suspend mode, enumeration	0 V
+5 V output current	Run mode, no other output loads	265 mA maximum (1.325 W).
Fuses	On USB supply	0452.750 - Littelfuse 0.750A NANO2® Slo-Blo® Subminiature Surface Mount Fuse. Spare fuse mounted in holder on PCB.

Note 1: This is the total current consumption for the USB-1208HS-4AO including +5 V, digital output and analog output currents.

Note 2: Output voltage range assumes input power is within specified limits.

USB specifications

Table 13. USB specifications

USB device type	USB 2.0 (high-speed)
USB device compatibility	USB 1.1, 2.0
USB cable length	5 meters maximum.
USB cable type	A-B cable, UL type AWM 2527 or equivalent (minimum 24 AWG VBUS/GND, minimum 28 AWG D+/D-).

Environmental

Table 14. Environmental specifications

Operating temperature range	0 to 50 °C
Storage temperature range	-40 to 85 °C
Humidity	0 to 90% non-condensing

Mechanical

Table 15. Mechanical specifications

Dimensions	127 mm (L) x 88.9 mm (W) x 35.56 (H))

Main connector and pin out

Table 16. Main connector specifications

Connector type	Screw terminal
Wire gauge range	16 AWG to 30 AWG

Table 17. Main connector pin out

Pin	Signal name	Pin	Signal name
1	AIN0	29	AOUT0
2	AGND	30	AOUT1
3	AIN1	31	AGND
4	AGND	32	AOUT2
5	AIN2	33	AOUT3
6	AGND	34	AGND
7	AIN3	35	AICKI
8	AGND	36	AICKO
9	AIN4	37	AOCKI
10	AGND	38	AOCKO
11	AIN5	39	TRIG
12	AGND	40	GND
13	AIN6	41	CTR0
14	AGND	42	CTR1
15	AIN7	43	TMR
16	AGND	44	GND
17	empty	45	empty
18	+5V	46	+5V
19	GND	47	GND
20	DIO0	48	DIO8
21	DIO1	49	DIO9
22	DIO2	50	DIO10
23	DIO3	51	DIO11
24	DIO4	52	DIO12
25	DIO5	53	DIO13
26	DIO6	54	DIO14
27	DIO7	55	DIO15
28	GND	56	GND

Measurement Computing Corporation
10 Commerce Way
Suite 1008
Norton, Massachusetts 02766
(508) 946-5100
Fax: (508) 946-9500
E-mail: info@mccdaq.com
www.mccdaq.com